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Samarina, A..

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Monetary targeting and financial system characteristics: An empirical analysis

Anna Samarina

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Research Institute SOM
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University of Groningen

Visiting address:
Nettelbosje 2
9747 AE Groningen
The Netherlands

Postal address:
P.O. Box 800
9700 AV Groningen
The Netherlands

T +31 50 363 7068/3815

www.rug.nl/som

Monetary targeting and financial system characteristics: An empirical analysis

Anna Samarina
University of Groningen
h.samaryna@rug.nl

Monetary Targeting and Financial System Characteristics: An Empirical Analysis

Anna Samarina*

University of Groningen

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Abstract

This paper investigates how reforms and characteristics of the financial system affect the likelihood of countries to abandon their strategy of monetary targeting. Apart from financial system characteristics, we include macroeconomic, fiscal, and institutional factors potentially associated with countries' choices to give up monetary targeting. Panel logit models are estimated on a sample of 35 monetary targeting countries over the period 1975-2009. The findings suggest that financial liberalization, deregulation, and development as well as dollarization significantly increase the likelihood to abandon monetary targeting. Additionally, more developed countries with lower inflation and larger fiscal deficits are more likely to quit this monetary strategy. However, the financial determinants of abandoning monetary targeting differ between advanced and emerging and developing countries.

JEL Classification: E52, E58, F41, G20.

Keywords: monetary targeting, financial system, money demand stability, logit.

* Faculty of Economics and Business, University of Groningen, PO Box 800, 9700 AV Groningen, The Netherlands. E-mail: h.samaryna@rug.nl; tel.: +31503636084.

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1. Introduction

The collapse of the Bretton Woods system in the mid-1970s forced countries to search for an alternative nominal anchor for monetary policy under the floating exchange rate regime. As a solution, the Monetary Targeting (MT) framework was created. Inspired by the quantitative theory of money propagated by monetarists, central banks of several advanced countries started using monetary aggregates as intermediate targets in their monetary policy conduct (Argy et al., 1990; Mishkin, 2006; Woodford, 2008). Central banks believed that targeting money growth could anchor inflation expectations and ensure price stability.

According to Argy et al. (1990) and Mishkin and Savastano (2001), MT involves the public announcement of medium-term targets for the growth rates of some monetary aggregate(s), the reliance of monetary policy conduct on information conveyed by this (these) aggregate(s), and strong accountability of a central bank to reach monetary targets. The success of MT relies on strong assumptions: stability of the money demand function and the existence of a strong and reliable relationship between the targeted monetary aggregates and goal variables - inflation and/or nominal income (Mishkin and Estrella, 1997; Mishkin, 2006).

Back in the 1970s, MT was considered a good alternative to exchange rate pegs. It was relatively easy to monitor and communicate this strategy to the markets. Moreover, monetary targets could be understood by the general public (Mishkin and Savastano, 2001; Mishkin, 2006). However, the initial enthusiasm about MT turned into a disappointment. The money demand function was unstable in most MT countries and central banks were unsuccessful in controlling the money stock. Additionally, MT central banks suffered a credibility loss as they frequently missed money growth targets. Exceptions were Germany and Switzerland, where MT was effective in controlling inflation thanks to the active and clear communication of the strategy to the public (Mishkin, 1999).[1] The sustained costs of MT implementation, including low institutional credibility and failure to achieve price stability, forced countries to quit this strategy.[2] Until the late 1990s, all advanced countries abandoned MT. Meanwhile, many emerging and developing economies adopted MT in the 1980s and 1990s, and some of them are still pursuing it at present (Roger, 2009).

This paper investigates the causes and conditions that led countries to MT abandonment. Mainly, we are interested in the impact of financial system characteristics and reforms on the probability that countries give up MT.

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[1] Some studies argue that German monetary policy during 1974-1998 was closer to inflation targeting than MT, as the Bundesbank announced inflation targets and used inflation forecasts in its monetary policy decision-making (Bernanke and Mihov, 1997; Mishkin, 1999).

[2] McCallum (1985) provides an elaborate review of the major criticisms and costs of MT.

Although advanced countries do not pursue MT anymore, this research is highly relevant for emerging and developing countries which are still implementing MT, but may decide in the near future to give it up. Thus, it could be important for policy-makers in these countries to identify and monitor the factors that may lead to the ineffectiveness and abandonment of MT.

While the instability of money demand function is frequently mentioned in the literature as a major cause of the MT breakdown (Mishkin, 1999; Woodford, 2008), some macroeconomic, financial, and institutional characteristics of countries created unfavorable conditions for the implementation of MT and, consequently, increased the probability of its abandonment. In particular, reforms and changes in financial systems brought more diversification, deregulation, and development of financial products and services. This led to intensive and unrestricted flows of capital and money within the economy. As a result of these changes, it became difficult for central banks to control domestic credit and broad money supply. Under these circumstances, central banks frequently missed money growth targets and eventually abandoned MT.

While there is an extensive literature that analyses prerequisites of MT adoption, evidence on the causes of its abandonment is scarce. To our knowledge, only the paper by Calderón and Schmidt-Hebbel (2008) employs discrete-choice models to estimate the determinants of MT choice. However, there is so far no study that empirically analyzes the causes of MT abandonment and the role of financial system characteristics and reforms in this respect.

This paper contributes to the existing literature by empirically examining several characteristics of financial systems that could contribute to MT abandonment. Financial system characteristics cause money demand instability, which directly influences monetary policy conduct and effectiveness of MT. We also include macroeconomic, fiscal, and institutional control variables potentially associated with countries' decisions to leave MT. We apply panel logit models on a sample of 35 MT countries over the period 1975-2009.

Our findings suggest that financial liberalization, deregulation, and development as well as dollarization significantly increase the likelihood to abandon MT. Moreover, exchange rate regime affects the probability to give up MT differently conditional on the level of financial openness. Additionally, more developed countries with lower inflation and larger fiscal deficits are more likely to switch from MT to an alternative strategy. However, the financial determinants to abandon MT differ between advanced and emerging and developing countries.

The rest of the paper is structured as follows. Section 2 formulates the hypotheses based on theoretical literature. Section 3 and 4 describe the methodology and the data. Sections 5 and 6 provide the main results and sensitivity analysis, respectively, and Section 7 concludes.

2. The role of the financial system in the decision to abandon MT: hypotheses

Some studies argue that financial system changes, such as liberalization, deregulation, development, and dollarization destabilize money demand (McCallum, 1985; Argy et al. 1990; Issing, 1997; Houben, 1999; Roger, 2009). This means that money demand becomes less predictable and the linkages between monetary aggregates and macroeconomic variables (inflation and aggregate demand) weaken. Consequently, controlling the money stock becomes unfeasible and money growth targets are missed. This forces central banks to suspend MT. Goldfeld and Sichel (1990, p.300) emphasize the relevance of money demand for monetary policy and point out that "…a stable demand function for money has long been perceived as a prerequisite for the use of monetary aggregates in the conduct of policy."

The demand for real money is commonly specified as a negative function of nominal interest rate and a positive function of income. Following Goldfeld and Sichel (1990) and Ball (2001), the conventional money demand function has the form:

$$log\frac{M_t}{P_t} = \alpha_0 + \alpha_1 logY_t + \alpha_2 logR_t + \varepsilon_t, \quad (1)$$

where M_t, P_t, Y_t, and R_t are the money stock, the aggregate price level, real output, and the nominal interest rate, respectively; ε_t represents money demand shocks.

According to Judd and Scadding (1982), money demand is stable when three conditions are satisfied. First, there is a statistically significant relation between money demand and its determinants, and these determinants can correctly predict money demand. Second, money demand cannot depend on too many variables, as that reduces its predictability. Third, the determinants of money demand should be linked to the real economy. As Judd and Scadding (1982, p.993) conclude, "…a stable demand function for money means that the quantity of money is predictably related to a small set of key variables linking money to the real sector of the economy." Since it is difficult to include money demand stability in the model due to the lack of a suitable measure, we cannot directly analyze its effect on the probability of MT abandonment. Instead, we examine financial system changes and characteristics that cause money demand instability, and, consequently, indirectly contribute to the exit of MT.

Based on previous studies, we derive five hypotheses (four unconditional and one conditional) linking financial determinants with the probability to abandon MT.

Financial (capital account) liberalization

According to Issing (1997) and Houben (1999), liberalization of external capital and money movements leads to the instability of the relationship between money supply and

macroeconomic variables (inflation and nominal income). This makes the conduct of monetary policy based on targeting money growth more difficult.

By definition, capital account liberalization is a government's decision to allow capital to flow freely in (and out of) the country (Henry, 2007). It increases financial openness of the economy and leads to higher currency exposure. Under such conditions, achieving price stability through the control of monetary aggregates becomes unfeasible. Moreover, the subsequent changes in financial and monetary conditions, including shifts in the capital assets demand and uncontrolled growth of the money stock increase the risk of missing money growth targets. In this situation, central banks abandon MT as this strategy cannot reach its objectives. Our first hypothesis is therefore:

Hypothesis 1*: Financial liberalization increases the probability to abandon MT.*

Turning to practice, Germany completed liberalization of its cross-border capital flows before the Bundesbank decided to adopt MT, which may explain why monetary conditions were rather stable in this country during the MT period (Issing, 1997). In contrast, other countries removed capital controls after they adopted MT. This caused radical changes in the financial system and money growth dynamics, leading to the ineffectiveness of MT.

***Policy trilemma*: exchange rate regime and capital mobility**

According to the *policy trilemma* hypothesis for open economies, a country can reach at the same time only two out of three policy objectives – monetary policy autonomy, capital mobility, and exchange rate stability (Obstfeld et al., 2005; Krugman and Obstfeld, 2009, Chapter 22). Thus, conditional on the level of capital mobility (capital account liberalization), the choice of exchange rate regime may have a different impact on the probability of MT abandonment.

If a country allows free movements of capital, it cannot simultaneously pursue independent monetary policy and achieve exchange rate stability. With no capital restrictions in place and volatile exchange rates, countries often experience the "fear of floating" (Calvo and Reinhart, 2000). To reduce exchange rate volatility, they limit exchange rate movements of their domestic currencies. Once a central bank focuses on pegging exchange rates, controlling the money stock becomes unfeasible due to the conflict between the objectives of exchange rate and price stability (Houben, 1999; Mishkin and Savastano, 2001). Thus, countries with fixed exchange rates will be more likely to abandon MT, conditional on high international capital mobility.

However, if there is limited capital mobility, a central bank can retain policy autonomy and have a fixed exchange rate regime (Obstfeld et al., 2005). Hence, countries with fixed exchange

rates can still practice independent monetary policy based on money growth targets. Our second, conditional, hypothesis is:

Hypothesis 2: *Countries with fixed exchange rate regimes are less (more) likely to abandon MT when they have limited (full) capital mobility.*

Financial deregulation

Financial deregulation is defined as the process of removing government restrictions, controls and regulations of the financial system (Gropp et al., 2007; Abiad et al., 2008). While financial liberalization is mainly associated with unrestricted external capital flows, domestic financial deregulation covers a broad range of financial reforms, such as removing credit, interest rate, and securities' markets controls, eliminating entry barriers into the financial system for new financial institutions, reducing bank reserve requirements and state ownership in the banking sector, and abolishing other administrative restrictions (Abiad et al., 2008).[3]

Financial deregulation may destabilize money demand and undermine the usefulness of monetary aggregates in monetary policy (McCallum, 1985; Issing, 1997; Houben, 1999). For instance, deregulation of interest rates in advanced countries in the 1980s freed banks in their credit activities, increased the competitiveness of the banking sector and financial intermediaries, and made it difficult for central banks to control domestic credit (Argy et al., 1990). These changes resulted in higher than targeted money growth and weaker relationship between targeted aggregates, GDP, and inflation. Consequently, central banks could not ensure price stability and were forced to leave MT. The next hypothesis is therefore:

Hypothesis 3: *Financial deregulation increases the probability to abandon MT.*

After the introduction of MT, Germany did not experience considerable changes in its financial regulatory framework (Issing, 1997). As a result, it managed to preserve a stable relationship between monetary aggregates and inflation. Meanwhile, financial deregulation in the 1980s in Switzerland made monetary conditions unstable and reduced the effectiveness of MT (Rich, 1997).

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[3] Financial deregulation is sometimes confused with financial innovation. While the former refers to the removal of restrictions and controls in the financial system, the latter captures technological advances that improve the access to information and processing of financial transactions as well as create new financial products, services and market segments (see Tufano, 2003; Gropp et al., 2007). While financial innovation is driven by deregulation (Gropp et al., 2007), financial regulation can also lead to innovations, e.g. efficient deposit insurance schemes, uniform accounting standards (De Haan et al. 2009). We do not include financial innovation in the analysis due to the lack of data on a suitable proxy for most of the analyzed countries.

Financial development

Another possible cause of MT abandonment is the development of financial markets. The emergence of credit and various money substitutes, especially interest-bearing ones, and their intensive circulation increase the income velocity of money, which in turn affects the transactions demand for money, making it unstable in the long run (Bordo and Jonung, 1990; Tan, 1997). This hinders the central bank's control of money growth and undermines the effectiveness of MT (Bordo and Jonung, 1990).

Note that the relationship between money supply and inflation is found to be stable in several developing countries whose central banks are currently pursuing MT (Madagascar, Mongolia) (see Slok, 2002; Nassar, 2005). These countries have relatively underdeveloped financial and banking sectors, with rather low ratios of stock market capitalization and bank credit to GDP. This could explain why their monetary conditions are still favorable for MT implementation. Thus, the fourth hypothesis is:

Hypothesis 4: *Financial system development increases the probability to abandon MT.*

Calderón and Schmidt-Hebbel (2008) find that countries with developed financial markets are more likely to leave MT.

Financial dollarization

Emerging and developing countries often experience financial dollarization. This means that households, firms, and financial institutions prefer to hold their assets and liabilities in foreign currency (usually US dollars) to protect them from high domestic currency inflation and uncertain economic situations (Keller and Richardson, 2003; Levy-Yeyati, 2006). This alters capital and money flows in financial markets and increases the volatility of money demand, making it unstable (Levy-Yeyati, 2006). As a result, central banks find it difficult to control the money stock. Monetary policy based on MT loses credibility as central banks miss money growth targets and fail to ensure price stability. Our final hypothesis is:

Hypothesis 5: *Financial dollarization increases the probability to abandon MT.*

The explanatory variables used to test the formulated hypotheses are described in Section 4.

3. Methodology

Our empirical approach is based on event history analysis that examines the probability of an event occurring at the observed time.[4] Suppose that at each time period a central bank can be in one of two states: state 0 corresponds to implementation of MT strategy, state 1 – an alternative, non-monetary targeting (nMT) strategy. The event of interest is the abandonment of MT and switch to nMT strategy. As central banks generally do not return to MT after they leave it, MT becomes a non-recurrent state. This implies that the probability of switching from nMT to MT is zero, while the probability to continue pursuing nMT strategy is one. Here, we focus on a single event of MT abandonment and examine how its likelihood depends on different determinants.

In order to analyze time-series cross-section data with a binary dependent variable (BTSCS), we apply panel binary choice models.[5] We use the logit specification as it constraints probabilities to lie within the unit interval and produces good statistical inference.

In each year only one of two outcomes takes place: the central bank abandons MT or does not. Let y_{it} be a binary dependent variable that takes the value 0 if a central bank of country i implements MT in year t (event does not occur) and 1 if it abandons MT in year t (event occurs). The corresponding observation rule is:

$$y_{it} = \begin{cases} 1 \; if \; y_{it}^* > 0 \\ 0 \; if \; y_{it}^* \leq 0 \end{cases}, \tag{2}$$

where y_{it}^* is the unobserved latent variable. The underlying model for the latent variable is:

$$y_{it}^* = \alpha + \beta' EXPL_{i,t-1} + \gamma' CTRL_{i,t-1} + \mu_i + \varepsilon_{it}, \qquad i = 1, \dots, N; t = 1, \dots, T, \tag{3}$$

where α is a constant term; β and γ are vectors of parameter estimates; μ_i are country-specific effects; ε_{it} is the error term that follows a logistic distribution. $CTRL_{i,t-1}$ is a matrix of control variables. $EXPL_{i,t-1}$ is a matrix of explanatory variables, including: financial liberalization (*Lib*), exchange rate regime (*Exr*), the interaction term of exchange rate regime with liberalization, financial deregulation (*Der*), financial development (*Dev*), and financial dollarization (*Dol*):

$$\beta' EXPL_{i,t-1} = \beta_1' Lib_{i,t-1} + \beta_2' Exr_{i,t-1} + \beta_3' (Exr * Lib)_{i,t-1} + \beta_4' Der_{i,t-1} + \beta_5' Dev_{i,t-1} + \\ + \beta_6' Dol_{i,t-1} . \tag{4}$$

The probability to abandon MT in year t is formulated as follows:

$$P\left(y_{it} = 1 \middle| EXPL_{i,t-1}, CTRL_{i,t-1}, \mu_i\right) = \Lambda\left(\alpha + \beta' EXPL_{i,t-1} + \gamma' CTRL_{i,t-1} + \mu_i\right), \tag{5}$$

where $\Lambda(.)$ denotes the logistic cumulative distribution function.

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[4] The event history analysis for time-series cross-section data with a binary dependent variable is described in Beck et al. (1998).

[5] The econometric methodology, used in this paper, is described in Cameron and Trivedi (2005, Chapter 23) and Baltagi (2008, Chapter 11).

The important modeling step in panel data analysis includes the treatment of country-specific effects μ_i that control for unobserved cross-country heterogeneity. Depending on the assumptions about these effects, we may distinguish three model specifications:

1) The coefficient estimate and variance of μ_i are insignificant, indicating that country-specific effects do not exist in the data. In this case we estimate a pooled-data logit model.

2) μ_i are random effects, uncorrelated with regressors: $\mu_i|EXPL_{i,t-1}, CTRL_{i,t-1} \sim N(0, \sigma_\mu^2)$. The appropriate model is the random effects logit model.

3) μ_i are fixed effects, correlated with regressors. With large *N,* the presence of fixed effects causes the incidental parameters problem, as the number of parameters μ_i increases with the number of countries in the sample (Baltagi, 2008). This problem is eliminated by estimating the conditional fixed effects logit model (Cameron and Trivedi, 2005; Baltagi, 2008).[6]

To examine which model specification fits the data, we estimate all three types of logit and compare them by using a Hausman test. The models are estimated by Maximum Likelihood.

The described models have their advantages and drawbacks. Pooled-data and random effects logit models use the full sample for estimation, but their results are inconsistent in the presence of fixed effects. Fixed effects logit models produce consistent and efficient parameter estimates when unobserved country-specific effects are correlated with regressors. However, it drops the entire control group, i.e. countries that have not left MT at the end of the analyzed period. In addition, while pooled-data and random effects logit models explain the variation observed *between* countries, fixed effects logit models describe the variation *within* countries (Baltagi, 2008). This comparison is important for the interpretation of the estimation results.

Another methodological issue refers to the analysis of interaction effects. It is not possible to interpret the interaction effect in nonlinear models by simply examining the coefficients on constituent variables and their interaction term (Brambor et al. 2006). Therefore, we follow the approach of Ai and Norton (2003) and Brambor et al. (2006) to calculate the correct interaction effect. The total marginal effect of exchange rate regime on the likelihood to leave MT, conditional on capital mobility (financial liberalization), is measured as:

$$\frac{\partial \Lambda(.)}{\partial Exr_{i,t-1}} = \left(\beta_2' + \beta_3' Lib_{i,t-1}\right) * \Lambda(.) \qquad (6)$$

The interaction effect and its significance can vary for different levels of capital mobility. It is not possible to calculate the interaction effect for fixed effects logit, hence we evaluate and present it only for pooled-data logit.

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[6] However, for the panel probit model the incidental parameter problem cannot be avoided. There is no fixed effect probit estimator that would produce consistent parameter estimates. For this reason we use the logit specification.

Since we analyze the probability of leaving MT, we only retain observations for countries from the start of MT until the year of its abandonment. All the explanatory variables are lagged one year as the current decisions of central banks to exit MT rely on the available history of macroeconomic, financial, and other indicators. We include only one lag of each variable since adding more lags may lead to a significant loss of degrees of freedom.

4. Data Description

Country sample

Our sample consists of 35 countries that implemented MT over the period 1975-2009. We include in the study two groups of MTers: 24 countries that implemented and abandoned MT in the analyzed period (MT-"leavers") and 11 countries that continue implementing MT (MT-"stayers").[7] The latter serves as a control group. Time-series observations for each country start in the year of MT adoption and end in the year of its abandonment (year 2009 for MT-"stayers"). Duration of MT varies from 4 to 29 years in different countries. Consequently, the panel dataset is unbalanced. Table 1 lists MT countries and shows the dates of adoption and (where applicable) abandonment of MT. Following the IMF classification, we distinguish 13 advanced and 22 emerging and developing MT countries.

Independent variables

To test the hypotheses formulated in Section 2, we include five variables in the model. As a proxy for financial liberalization, we employ the Chinn-Ito index of capital account openness (Chinn and Ito, 2008). The index uses the information on the restrictions on cross-border financial transactions reported by the IMF's Annual Report on Exchange Arrangements and Exchange Restrictions. To examine the conditioning effect of capital mobility, we include an interaction term of exchange rate regime with financial liberalization. The exchange rate regime indicator is based on the de facto "fine" classification of Reinhart and Rogoff (2004).

The financial deregulation index is based on the dataset constructed by Abiad et al. (2008) and includes five dimensions of financial reforms: credit controls and reserve requirements, interest rate controls, entry barriers, privatization of banking sector, and government policies towards securities markets.[8] A higher value of the index indicates more deregulation of the financial system.

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[7] A similar division of MT countries is used by Calderón and Schmidt-Hebbel (2008) who distinguish "MT movers" and "MT stayers".

[8] The financial reform index of Abiad et al. (2008) includes also capital account liberalization and banking sector supervision. However, these dimensions are excluded from our indicator. Capital account liberalization is measured by the Chinn-Ito index; and banking sector supervision does not fit the definition of financial deregulation.

Table 1. List of countries with dates of adoption and abandonment of MT

Countries that implemented and abandoned MT – MT-"leavers"			Countries that did not abandon MT – MT-"stayers"	
Advanced (13)			Advanced (0)	
Country	Dates	Post-MT monetary strategy	Country	Dates
Australia	1976-1985	inflation targeting (from 1993)		
Canada	1976-1983	inflation targeting (from 1991)		
France	1977-1999	ECB strategy (EMU member from 1999)		
Germany	1975-1999	ECB strategy (EMU member from 1999)		
Greece	1975-1998	ECB strategy (EMU member from 2001)		
Italy[a]	1985-1999	ECB strategy (EMU member from 1999)		
Japan	1978-1999	implicit price stability anchor (from 2001)		
Korea	1979-1998	inflation targeting (from 1998)		
Slovenia	1997-2001	exchange rate targeting (2001-2006), ECB strategy (EMU member from 2007)		
Spain	1978-1995	inflation targeting (1995-1998), ECB strategy (EMU member from 1999)		
Switzerland	1975-2000	inflation targeting (from 2000)		
United Kingdom	1976-1992	inflation targeting (from 1993)		
United States	1975-1996	implicit price stability anchor (from 1996)		
Emerging and developing (11)			Emerging and developing (11)	
Albania	1993-2006	transition to inflation targeting (from 2006)	Bangladesh	2003-on
Egypt	1996-2005	transition to inflation targeting (from 2005)	China	1994-on
Ghana	1992-2007	inflation targeting (from 2007)	Madagascar	1994-on
Guatemala	1993-1996	multiple monetary policy targets (1996-2004), inflation targeting (from 2005)	Mongolia	1995-on
India	1985-1998	multiple indicators approach (from 1998)	Mozambique	1992-on
Indonesia[b]	1997-2005	inflation targeting (from 2005)	Nigeria	1986-on
Moldova	1994-2009	transition to inflation targeting (from 2009)	Pakistan[a]	1995-on
Philippines	1985-1995	transition to inflation targeting (1995-2001), inflation targeting (from 2002)	Sri Lanka	1981-on
Russia	1993-2004	multiple monetary policy targets (from 2004)	Tanzania	1995-on
South Africa	1986-2000	inflation targeting (from 2000)	Tunisia	1987-on
Thailand[b]	1997-2000	inflation targeting (from 2000)	Uganda	1993-on

Notes: The analyzed sample does not include several developing countries that claim to pursue MT, but for which we are unable to find the exact dates of adoption (and abandonment) of MT. These countries are mentioned in the IMF De Facto Classification of Exchange Rate Regimes and Monetary Policy Frameworks.

The first date refers to the adoption year; the second date refers to the year of MT abandonment.

[a] Italy applied direct credit targeting during 1974-1984, from 1985 it started targeting M2; similarly, Pakistan used credit ceilings and targets during 1973-1994, in 1995 M2 became an official monetary target.

[b] These countries adopted base money targeting under the IMF-supported program for post-crisis economic recovery.

Sources: Argy et al. (1990), Houben (1997), Houben (1999), Sterne (2001), Festić (2002), Fatás et al. (2004), Stone and Bhundia (2004), Fane (2005), Nassar (2005), Al-Mashat and Billmeier (2007), Patra and Kapur (2010), IMF De Facto Classification of Exchange Rate Regimes and Monetary Policy Frameworks, central banks' publications.

Following Levine et al. (2000) and Beck et al. (2009), financial development is measured by the ratio of domestic credit provided by the banking sector to GDP.

De Nicoló et al. (2003) distinguish three types of dollarization: payment dollarization corresponds to the use of foreign currency in transactions; financial dollarization refers to residents' holdings of financial assets and liabilities in foreign currency; and real dollarization, i.e. indexing of prices in foreign currency. Given these definitions, it is suitable for our analysis to use the proxy for financial dollarization, measured as the ratio of foreign currency deposits to total bank deposits. The data for this measure is compiled from the Financial Dollarization Dataset of Levy-Yeyati (2006), as well as national and central banks' statistics. However, this variable is missing for 49% of all observations in our sample. Therefore, we substitute deposit dollarization with a reserves' dollarization proxy (the ratio of foreign currency reserves to total reserves), the data for which is available for the whole sample. The shortcoming of this measure is that it reflects payment dollarization (De Nicoló et al. 2003) and is not strongly linked to deposit dollarization (correlation between these proxies is 0.21).[9] To test the robustness of results to different specifications of dollarization, we include reserves' dollarization in the main analysis and deposit dollarization - in the sensitivity analysis.

Table A1 in the Annex provides a detailed description of all variables and their data sources.

Control variables

Apart from explanatory variables, we include six control variables that capture macroeconomic, fiscal, and institutional factors potentially associated with MT abandonment.

The first control variable is the log of real GDP per capita measuring the level of economic development. Economic development is strongly related to financial development (De Haan et al., 2009). Also, Calderón and Schmidt-Hebbel (2008) argue that MT is more often implemented in emerging and developing countries than in advanced ones. Due to the failure of MT to ensure price stability and due to the accession of some MT countries to the EMU, this strategy disappeared in the monetary policy framework of advanced countries by the late 1990s and is currently used only by emerging and developing economies (Stone and Bhundia, 2004; Roger, 2009). Thus, higher economic development can increase the probability to give up MT.

Next, we include the CPI inflation rate, transformed to minimize the impact of hyperinflation episodes (see Table A1 in the Annex). During the 1970s, advanced countries experienced high inflation caused by oil price shocks and followed by volatile growth of monetary aggregates.

[9] Although payment dollarization does not necessarily lead to financial dollarization, high reserves' dollarization combined with pegged exchange rates can encourage financial dollarization due to market failures, foreign currency deposit insurance, and extensive government guarantees to bank creditors (De Nicoló et al., 2003).

These countries with the history of high inflation used money growth targets to achieve price stability (Argy et al., 1990; Rich, 1997; von Hagen, 1999). However, once inflation was brought down to sustainable levels, countries preferred to switch to alternative monetary policy strategies (such as inflation targeting) that helped to maintain low and stable inflation. Thus, we expect the negative impact of inflation on the probability to leave MT.

Previous studies emphasize that successful implementation of MT requires the existence of a strong relationship between monetary aggregates and inflation (Argy et al., 1990; Issing, 1997; Mishkin and Estrella, 1997; Houben, 1999; Mishkin and Savastano, 2001). High money growth volatility makes this relationship weaker and less predictable in the long run. It increases the risk of missing money growth targets and jeopardizes the effectiveness of MT. Money growth volatility is measured by the 3-year rolling standard deviation of annual money growth rates.

We introduce trade openness measured as the sum of exports and imports (as a percentage of GDP) as a proxy for the external exposure of an economy. Open economies that are vulnerable to commodity prices and exchange rate shocks often prefer to focus on exchange rate rather than price stability. Moreover, external shocks may destabilize the relationship between monetary aggregates and inflation, which will increase the risk of MT abandonment.

The last two control variables are fiscal and institutional. We include the general government fiscal balance (in percentage of GDP) as a proxy for fiscal discipline. In order to pursue credible monetary policy through controlling money growth, central banks should not be forced to finance fiscal deficits (Mishkin and Savastano, 2001). Inadequate fiscal discipline could cause poor monetary policy decisions and, consequently, lead to the failure of MT in reaching price stability. Fiscal balance is expected to have a negative effect on the probability to abandon MT.

Central bank independence is a relevant institutional factor. Central banks with low political and economic independence are vulnerable to political pressures for higher inflation to stimulate short-term economic growth (Mishkin, 2006). This makes any monetary strategy unsuccessful in achieving price stability. MT central banks with low independence are especially ineffective as their ultimate goal of low inflation is linked to the intermediate money growth target (McCallum, 1985), and the actual money growth could be manipulated by central banks under government pressures. Measuring central bank independence is difficult, especially for emerging and developing countries. The legal index of central bank independence may be a poor proxy for actual independence, as it is based on official documents of central banks. Many central banks in emerging and developing countries do not fully respect the rule of law. For this reason, we construct the actual central bank independence (ACBI) index as an interaction term of legal index and the rule of law. The legal index is based on the data of Arnone et al. (2007)

and includes political and economic aspects of central bank independence. Using the method of Klomp and De Haan (2010) to pinpoint the exact year when the change in legislation enhanced central bank independence, we use the information in Cukierman et al. (2002) and Acemoglu et al. (2008) on major changes of central bank laws. The rule of law is based on the Law and Order index of International Country Risk Guide database (also used by Klomp and De Haan, 2010).

Imputation of missing observations

Before carrying out the estimations, we have to deal with missing observations. The data for five variables (financial liberalization, financial deregulation, financial development, money growth volatility, and rule of law) are missing for some years in the sample. The percentage of missing observations varies from 1% to 17% of all observations. We apply the Expectation-Maximization (EM) algorithm introduced by Demster et al. (1977) and described by Schafer (1997). It is a standard imputation technique for filling in missing observations. We use the EM algorithm of SPSS, under the assumption that the data are normally distributed.[10]

Descriptive statistics – mean comparison tests

Table 2 reports the mean comparison tests for all independent variables. We compare the means of variables in two country groups – MT-"leavers" and MT-"stayers". We apply a two-sided mean comparison t-test, where the null hypothesis is that the mean difference of two groups is zero: H_0*: mean (MT-"leavers") – mean (MT-"stayers") = 0.*[11] The alternative hypothesis is that the mean difference is not zero. We perform mean comparison tests for unequal variances of variables in two groups.[12]

The statistics show that MT-"leavers" have on average more liberalized, deregulated and developed financial systems as well as more flexible exchange rate regimes than MT-"stayers". Additionally, MT-"leavers" are characterized by lower dollarization than MT-"stayers". The mean differences of all financial variables are statistically significant.

Regarding the control variables, on average MT-"leavers" are more economically developed and less open. MT-"leavers" do not differ statistically from MT-"stayers" in terms of money growth volatility, inflation and fiscal balance. Finally, MT-"leavers" have higher actual central bank independence than MT-"stayers". Note that if we use the legal independence index instead of the actual one, we find no statistically significant mean difference between the groups.

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[10] Alternatively, we applied the EM algorithm for the mixed normal distribution and the *t* distribution of the data. However, these specifications did not produce sensible imputation results.

[11] We do not report the one-sided mean comparison tests that analyze whether mean differences are positive (negative). These tests are available upon request.

[12] The Bartlett's test statistic rejects the null hypothesis of equal variances, indicating that two groups have unequal variances for each variable. The exceptions are trade openness and fiscal balance, for which the variances are equal; we use the mean comparison test for equal variances in these two cases.

Table 2. Descriptive statistics - mean values comparison

Variable	MT-leavers	MT-stayers	P-value
Financial liberalization	0.63 (1.06)	-0.52 (1.52)	0.00
Financial deregulation	10.03 (3.46)	9.27 (3.09)	0.01
Financial development	0.90 (0.58)	0.38 (0.33)	0.00
Financial dollarization	0.73 (0.22)	0.96 (0.08)	0.00
GDP per capita (ln)	8.67 (1.54)	6.26 (0.69)	0.00
Inflation	0.09 (0.10)	0.10 (0.08)	0.24
Exchange rate regime	9.37 (3.39)	8.03 (2.95)	0.00
Money growth volatility	7.17 (14.38)	7.78 (9.15)	0.55
Trade openness	52.19 (25.79)	65.38 (24.45)	0.00
Fiscal balance	-3.72 (3.39)	-4.13 (3.54)	0.18
Central bank independence	2.34 (1.53)	1.77 (0.89)	0.00
Observations	360	195	

Notes: Table 2 reports means and standard deviations (in brackets) of independent variables in each MT group. For MT-"leavers", the statistics are calculated using the period of MT practice from adoption until abandonment. For MT-"stayers", we use the period from MT adoption until the end of 2009. The P-value<0.05 indicates the rejection of the null hypothesis and suggests that the mean difference of a particular variable is statistically significant.

Correlation analysis

We perform a correlation analysis to check for potential multicollinearity between the independent variables (see Tables A2 and A3 in the Annex). For the full sample (Table A2), most variables are not highly correlated with each other. However, there is a high and significant correlation between the economic development proxy and financial development. Apparently, more economically developed countries have better developed financial markets.[13] To avoid multicollinearity, we include these variables in model estimations separately.

For the subsample of MT-"leavers" (Table A3), high correlation is detected between economic development and two variables - financial liberalization and financial development. These financial determinants will be included in the fixed effects logit model without the economic development proxy. A similar approach is used with respect to the ACBI index that is highly correlated with financial liberalization.

5. Empirical results

This section discusses our main estimation results. The Hausman test, which compares the estimates of fixed effects with random effects logit, rejects the random effects null hypothesis in favor of the fixed effects model. Therefore, we report only the results of the pooled-data logit

[13] De Haan et al. (2009, Chapter 1) review several studies which have shown that financial development has a positive impact on economic growth and development.

model for *between* countries variation and the fixed effects logit model for *within* countries variation. Likelihood Ratio tests conducted on the residuals of pooled-data logit models indicate the presence of heteroscedasticity and autocorrelation. Therefore, we report robust standard errors clustered on the country.

When estimating a panel data model with large *T*, one should take into account the potential time dependency problem. This means that the probability of a country to abandon MT in year *t* may depend on the duration of MT in this country. Ignoring temporal dependence may lead to the underestimation of standard errors and too optimistic statistical inference (Beck et al. 1998). Following the approach of Beck et al. (1998), we add time dummies for each period counting the duration of MT to deal with temporal dependence. The results show that the coefficient estimates of the time dummies are jointly insignificant, indicating that temporal dependence is not a serious problem in the data.[14]

As pooled-data and fixed effects logit models explain different types of variation (*within* or *between* countries), it is difficult to compare their estimates. Thus, we interpret them separately. Table 3 presents the results of pooled-data logit estimation. For this model we report average marginal effects since coefficient estimates cannot be interpreted directly.[15] Columns 1-2 show the estimation results without the interaction term, while estimations in columns 3-5 include the interaction term. Additionally, in columns 2, 4 and 5 we exclude from the model either financial development or economic development as these variables are highly correlated with each other.

The findings from pooled-data logit suggest that most of the analyzed financial characteristics play a significant role in MT abandonment. There is strong evidence that countries which implement reforms in their financial systems and liberalize capital movements during the period of MT use, are more likely to leave MT. Additionally, the marginal effect of reserves' dollarization is significant with a positive sign, indicating that more dollarized economies have a higher probability to abandon MT. Financial deregulation, liberalization, and dollarization destabilize money demand and make the growth of monetary aggregates less predictable. This jeopardizes the effectiveness of MT in reaching monetary targets.

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[14] These estimation results are available upon request. Another technique to correct for temporal dependence, mentioned by Beck et al. (1998), is to use cubic splines that smooth time dummies. However, given that our panel dataset is unbalanced and that duration of MT varies between countries from 4 to 29 years, it is not possible to create splines with sufficient knots that will fit equally well for all countries. Thus, we do not use this approach.

[15] Average marginal effects are calculated as averages (over N and T) of individual marginal effects. Standard errors of these marginal effects are computed using the delta method (Cameron and Trivedi 2005, Chapter 14).

Table 3. Determinants of MT abandonment – pooled-data logit

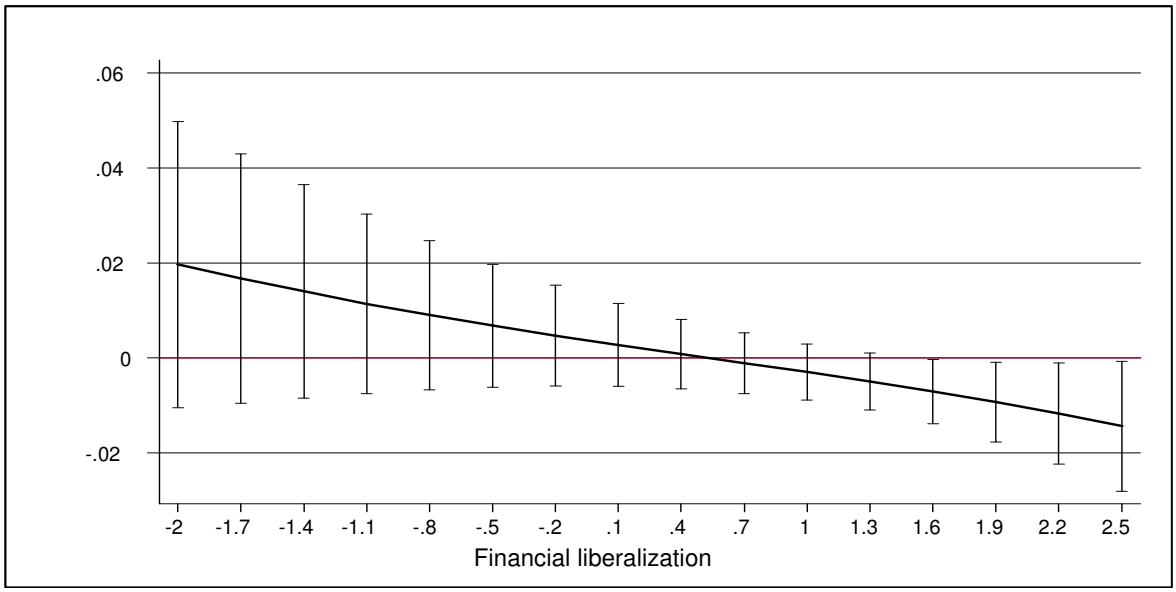
	1	2	3	4	5
Financial liberalization	0.004	0.004	0.051**	0.050**	0.045**
	(0.010)	(0.010)	(0.021)	(0.020)	(0.019)
Exchange rate regime	-0.004	-0.004	0.003	0.003	0.002
	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)
Exchange rate regime × Financial liberalization			-0.006***	-0.006***	-0.005**
			(0.002)	(0.002)	(0.002)
Financial deregulation	0.011**	0.011**	0.007*	0.007*	0.008**
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Financial development	-0.003		-0.005		0.016
	(0.022)		(0.021)		(0.016)
Financial dollarization	0.110**	0.107**	0.169***	0.165***	0.116***
	(0.050)	(0.041)	(0.060)	(0.056)	(0.053)
Economic development	0.009	0.008	0.015*	0.014*	
	(0.008)	(0.006)	(0.009)	(0.008)	
Inflation	-0.158	-0.150	-0.248	-0.235	-0.210
	(0.215)	(0.216)	(0.200)	(0.198)	(0.195)
Money growth volatility	-0.002	-0.002	-0.002	-0.002	-0.002
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
Trade openness	-0.00004	-0.0001	-0.0001	-0.0001	-0.0001
	(0.0004)	(0.0004)	(0.005)	(0.005)	(0.0001)
Fiscal balance	-0.002	-0.002	-0.001	-0.001	-0.0005
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Central bank independence	-0.002	-0.002	0.002	0.002	0.003
	(0.010)	(0.010)	(0.010)	(0.010)	(0.012)
Number of observations	520	520	520	520	520
Number of countries	35	35	35	35	35
Log likelihood	-86.77	-86.78	-83.54	-83.57	-84.55
Wald χ^2	22.44**	23.08**	23.18**	23.93**	24.09**

Notes: Table 3 reports average marginal effects and robust standard errors (in brackets) computed using the delta method. ***, **, and * indicate significance on 1%, 5%, and 10% significance level, respectively. The Wald $\chi 2$ test is equivalent to the F-test in linear regressions and evaluates the goodness-of-fit of the model.

The interaction term is significant with a negative sign in all the models. Figure 1 illustrates how the exchange rate regime influences the probability to abandon MT, depending on the level of financial liberalization. For low levels of liberalization, the marginal effect is positive (left side of Figure 1), implying that countries with flexible exchange rates are more likely to give up MT. Thus, money growth targets can be still used by countries under fixed exchange rate arrangements, given that they restrict capital flows. The opposite conclusion is drawn when capital mobility is high (right side of Figure 1). Here the marginal effect is negative. This suggests that countries with flexible exchange rate regimes are less likely to abandon MT; hence, it is not possible to have both fixed exchange rates and money growth targets. Our results are in line with the *policy trilemma* hypothesis. The interaction effect is significant for high

levels of financial liberalization (between 1.3 and 2.5), that counts for 28% of all observations in our sample.

Figure 1. The Effect of Exchange Rate Regime on the Likelihood to Abandon MT Conditional on the Level of Financial Liberalization



Notes: The thick line shows the marginal effect of exchange rate regime on the probability to leave MT at different levels of financial liberalization; vertical boundaries indicate the 95% confidence interval. The marginal effect is significant when the line and confidence intervals are above (below) zero.

Our findings from pooled-data logit support hypotheses H_1, H_2, H_3, and H_5, and reject hypothesis H_4. As for the control variables, we find that economically developed countries are more likely to abandon MT. The marginal effects for other variables are insignificant.

Next, we estimate the fixed effects logit model. This model discards the entire group of MT-"stayers" and explains the variation of determinants for MT abandonment *within* MT-"leavers". Since in fixed effects logit marginal effects depend on values of μ_i, they cannot be computed. Therefore, we report the coefficient estimates instead. Their signs correspond to the signs of marginal effects.[16] Table 4 reports the estimation results. Columns 1-2 show the estimations without the interaction term, while columns 3-4 include the interaction term. Since financial development is highly correlated with economic development, we include these variables in the

[16] The marginal effect of a change in a regressor on the conditional probability is calculated for logit model as:

$$\frac{\partial P[Y_{it}=1|X]}{\partial x_k} = \Lambda'(X,\alpha,\beta,\gamma,\mu_i)\beta_k$$

$\Lambda'(z) = \frac{\partial \Lambda(z)}{\partial z} > 0$, so the sign of the marginal effect depends only on β_k (Cameron and Trivedi, 2005, page 467).

estimation separately: columns 1 and 3 report the results for models without the economic development proxy, and columns 2 and 4 – models without financial development.[17]

The results show that the coefficient estimates of financial development and financial deregulation are significant with a positive sign, suggesting that reforms and development in the financial systems of MT-"leavers" increase their probability to abandon MT. The coefficient estimates of financial liberalization, exchange rate regime and their interaction term are insignificant. The outcomes confirm the hypotheses H_3 and H_4; other hypotheses are rejected.

The coefficient estimate for economic development is significant with a positive sign implying that more developed MT-"leavers" are more likely to leave MT. This result is in line with previous literature that argues that advanced countries do not practice MT anymore and that the strategy is currently implemented only in emerging and developing economies (Roger, 2009).

Our findings indicate that lower inflation significantly increases the likelihood of MT-"leavers" to quit MT. Central banks that achieve low inflation prefer to further maintain price stability with the help of a different monetary strategy than MT. Note that out of 24 MT-"leavers", 12 countries adopted inflation targeting after they left MT and another 3 countries are preparing to adopt inflation targeting as a strategy to keep inflation at the low sustainable level.

We find that money growth volatility is insignificant in all model specifications. This result is unexpected, given that the literature on MT assigns an important role to money demand stability as a crucial factor for the implementation of this strategy. Perhaps, the financial variables explain to some extent money demand stability and, therefore, serve as indirect determinants of MT abandonment.

Our results also show that higher fiscal deficits significantly increase the probability of MT-"leavers" to abandon MT. The coefficient estimate of the ACBI index is insignificant, which implies that central bank independence is not a relevant prerequisite for central banks to leave MT. A more important aspect could be the transparency of a central bank in communicating its monetary strategy and money growth targets to the public. If central banks communicate monetary policy-making in unclear way, central bank's credibility is reduced and the effectiveness of MT in reaching price stability is undermined (Mishkin, 1999). Due to the limited availability of data on the transparency index, we cannot incorporate this aspect into the analysis.

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[17] As financial liberalization is highly correlated with the ACBI index, we estimated models without the ACBI index and models without financial liberalization. That did not change the significance and signs of independent variables. These results are available upon request.

Table 4. Determinants of MT abandonment – conditional fixed effects logit

	(1)	(2)	(3)	(4)
Financial liberalization	1.162	1.243	2.084	5.347
	(1.310)	(2.303)	(1.740)	(8.701)
Exchange rate regime	-0.0657	-0.545	0.104	0.600
	(0.170)	(0.450)	(0.264)	(1.421)
Exchange rate regime × Financial liberalization			-0.113	-0.557
			(0.130)	(0.661)
Financial deregulation	1.160*	1.950	1.077*	1.746
	(0.642)	(1.825)	(0.604)	(1.540)
Financial development	17.04**		17.14**	
	(6.984)		(7.007)	
Financial dollarization	9.060	19.82	9.648	16.42
	(7.143)	(13.23)	(7.323)	(12.40)
Economic development		233.8*		206.1*
		(122.6)		(117.8)
Inflation	-52.05**	-294.2*	-50.19**	-246.2
	(21.73	(169.0)	(21.17)	(175.8)
Money growth volatility	-0.066	-0.074	-0.070	0.004
	(0.071)	(0.122)	(0.074)	(0.179)
Trade openness	0.110	0.614*	0.099	0.505
	(0.082)	(0.348)	(0.080)	(0.357)
Fiscal balance	-0.440*	-2.180*	-0.356	-1.798
	(0.246)	(1.129)	(0.267)	(1.158)
Central bank independence	1.716	-0.614	1.766	-0.867
	(1.177)	(3.430)	(1.221)	(1.802)
Number of observations	336	336	336	336
Number of countries	24	24	24	24
Log likelihood	-21.68	-7.37	-21.28	-6.67
Likelihood Ratio χ^2	76.21***	104.8***	77.03***	106.2***

Notes: Table 4 reports coefficient estimates and standard errors (in brackets). ***, **, and * indicate the significance on 1%, 5%, and 10% significance level, respectively. LR $\chi 2$ test is equivalent to the F-test in linear regressions and evaluates the goodness-of-fit of the model.

6. Sensitivity analysis

We investigate whether our findings are sensitive to the inclusion of countries in the analyzed sample, to estimations for sub-samples, and to modifications of variables. Most of the results are presented in Table 5. We report only pooled-data logit estimations as they use the full sample and are easier to interpret. Robustness checks using fixed effects logit are available on request.

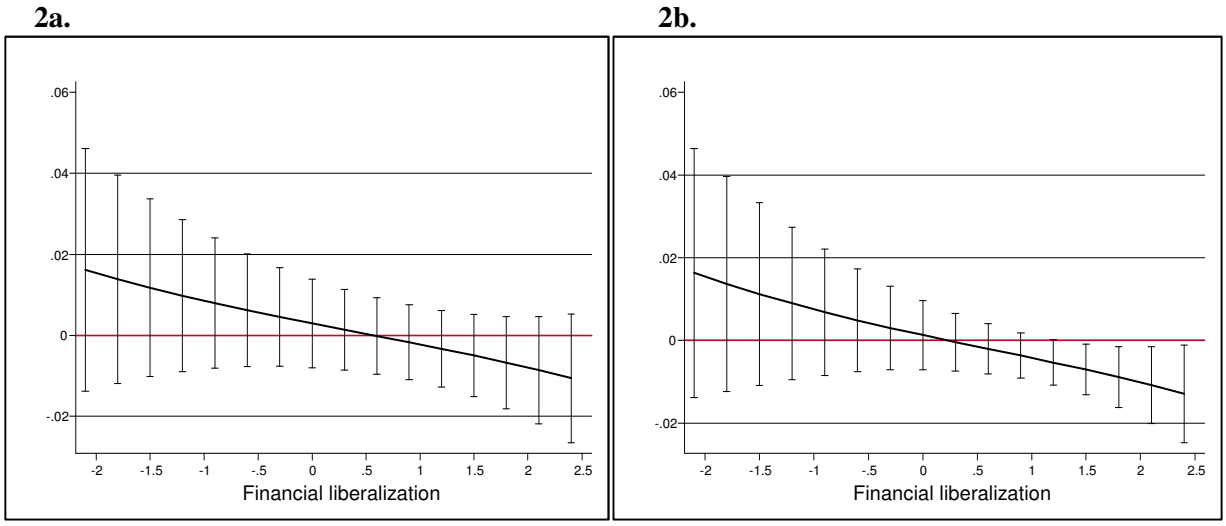
First, we drop observations for four EMU countries (France, Germany, Greece, and Italy). These countries abandoned MT when they joined the euro area.[18] In this situation, abandoning MT was not caused by macroeconomic or financial factors but was a predetermined institutional

[18] We do not drop observations for Spain, as its MT abandonment was followed by the adoption of inflation targeting in 1995. Inflation targeting was implemented in Spain until it joined the EMU in 1999.

agreement of central banks to delegate the conduct and choice of monetary policy strategy to the European Central Bank. The estimation results for the sample without the mentioned EMU countries are shown in columns 1a-1b of Table 5. Marginal effects of financial liberalization and dollarization remain significant with positive signs; financial deregulation becomes insignificant in the model with the interaction term. Figure 2a shows that the marginal effect of exchange rate regime conditional on financial liberalization is insignificant for all levels of liberalization. Other variables do not change substantially. We conclude that dropping the EMU countries from the sample does not lead to considerable changes of our main results except for making the interaction effect insignificant.

Second, we exclude observations for two South-East Asian countries, Indonesia and Thailand. These countries adopted money-based targeting under the IMF-supported program for the economic recovery in the aftermath of financial crisis in 1997-1998 (Fane, 2005). Here, MT is treated as a temporary institutional solution under crisis conditions rather than a monetary strategy with long-term objectives. The estimation results without these two countries are shown in Table 5, columns 2a-2b. The outcomes do not change substantially compared to Table 3. Financial liberalization, deregulation, and dollarization as well as economic development still have significant impact on the probability to leave MT. Figure 2b shows that the interaction effect of exchange rate regime with financial liberalization is significant with a negative sign for high levels of liberalization (between 1.2 to 2.5). Thus, our main conclusions are robust to the exclusion of Indonesia and Thailand from the MT-"leavers" group.

Figure 2. The Effect of Exchange Rate Regime on the Likelihood to Abandon MT Conditional on the Level of Financial Liberalization (sensitivity analysis)



Notes: The thick line shows the marginal effect of exchange rate regime on the probability to leave MT at different levels of financial liberalization; vertical boundaries indicate the 95% confidence interval. The marginal effect is significant when the line and confidence intervals are above (below) zero. Figure 2a presents the interaction effect for the sample without 4 EMU countries, Figure 2b without Indonesia and Thailand.

Third, we split the sample into advanced countries and emerging and developing ones. As splitting the dataset leads to fewer observations in each subsample, the results should be interpreted with caution. Since we divide the sample by an economic development criterion, we do not include the economic development proxy to control for country heterogeneity.

The results for advanced countries (Table 5, columns 3a-3b) are comparable to the ones for the full sample. However, only financial dollarization and liberalization are relevant for the probability of advanced countries to leave MT and the interaction effect is only marginally significant (the graph does not show any significant areas; available upon request).

The results for emerging and developing economies (Table 5, columns 4a-4b) are different than those of the advanced countries. Financial deregulation and dollarization become insignificant, while the marginal effects of financial liberalization and development have significant positive impact on the probability of MT abandonment. Thus, emerging and developing countries that liberalize capital flows and develop their financial systems during the period of MT practice are more likely to quit this monetary strategy. The interaction term is insignificant with a positive sign.

Finally, we re-estimate all models with a proxy for deposit instead of reserves' dollarization. The results are not substantially affected by this modification, but deposit dollarization is insignificant in all the models.[19] Due to the limited data availability of deposit dollarization, the estimations are carried out on a much smaller sample. Consequently, the real impact of this variable could be largely underestimated. Nevertheless, the positive sign on its marginal effect suggests that higher deposit dollarization may increase the likelihood of countries to leave MT.

The robustness analyses show that our main conclusions are to some extent sensitive to the modifications and selection of the countries. Particularly, the findings for emerging and developing countries differ from the ones for the full sample and advanced countries. This could be explained by considerable heterogeneity of the analyzed countries that practice MT.

[19] These estimation results are available upon request.

Table 5. Sensitivity analysis

	Without 4 EMU countries		Without Indonesia and Thailand		Advanced countries		Emerging and developing countries	
	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)	(4a)	(4b)
Financial liberalization	0.003	0.044*	0.003	0.043**	0.021	0.108*	0.013*	0.007*
	(0.011)	(0.024)	(0.011)	(0.018)	(0.046)	(0.065)	(0.008)	(0.016)
Exchange rate regime	-0.001	0.003	-0.005*	0.001	-0.010	0.012	0.002	0.002
	(0.005)	(0.005)	(0.003)	(0.004)	(0.008)	(0.011)	(0.003)	(0.003)
Exchange rate regime × Financial liberalization		-0.005**		-0.005***		-0.011**		0.001
		(0.002)		(0.002)		(0.005)		(0.002)
Financial deregulation	0.008*	0.006	0.011**	0.008**	0.009	0.009	0.005	0.005
	(0.005)	(0.004)	(0.004)	(0.004)	(0.009)	(0.011)	(0.003)	(0.004)
Financial development	-0.012	-0.010	-0.009	-0.011	-0.031	-0.033	0.043***	0.043***
	(0.031)	(0.026)	(0.023)	(0.022)	(0.040)	(0.040)	(0.012)	(0.012)
Financial dollarization	0.149**	0.164***	0.112**	0.158**	0.246*	0.342*	0.083	0.075
	(0.076)	(0.063)	(0.047)	(0.053)	(0.145)	(0.185)	(0.082)	(0.089)
Economic development	0.015	0.017*	0.012	0.017*				
	(0.010)	(0.009)	(0.008)	(0.009)				
Inflation	-0.102	-0.203	-0.035	-0.126	-0.823	-0.778	-0.132	-0.129
	(0.187)	(0.183)	(0.170)	(0.159)	(0.647)	(0.661)	(0.194)	(0.195)
Money growth volatility	-0.001	-0.001	-0.002	-0.002	-0.003	-0.002	-0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.003)	(0.002)	(0.002)
Trade openness	-0.00004	-0.0001	-0.0002	-0.0003	0.0002	-0.0001	0.0003	0.0003
	(0.001)	(0.001)	(0.0004)	(0.0005)	(0.001)	(0.001)	(0.0005)	(0.0005)
Fiscal balance	-0.003	-0.002	-0.001	-0.001	-0.007	-0.008	0.003	0.003
	(0.004)	(0.004)	(0.003)	(0.003)	(0.007)	(0.008)	(0.003)	(0.003)
Central bank independence	-0.001	0.001	0.00005	0.003	0.005	0.011	-0.017	-0.017
	(0.015)	(0.014)	(0.009)	(0.010)	(0.020)	(0.018)	(0.019)	(0.019)
Number of observations	437	437	509	509	222	222	298	298
Number of countries	31	31	33	33	13	13	22	22
Log likelihood	-73.85	-71.99	-79.88	-77.29	-40.88	-38.67	-40.37	-40.34
Wald χ^2	29.05***	24.17**	21.27**	30.32***	37.30***	118.2***	18.05**	18.43*

Notes: Table 5 reports average marginal effects and robust standard errors (in brackets) computed using the delta method. ***, **, and * indicate significance on 1%, 5%, and 10% significance level, respectively. The Wald χ^2 test is equivalent to the F-test in linear regressions and evaluates the goodness-of-fit of the model. Columns (a) show the estimation results without the interaction term, and columns (b) – with the interaction term.

7. Conclusions

This paper investigates the role of financial system characteristics and reforms in the abandonment of MT by countries. Previous studies ignore financial system characteristics and empirical evidence on the determinants of MT abandonment is very limited. We formulate five hypotheses for financial system characteristics and include six control variables that could be associated with countries' decisions to leave MT. We apply panel (pooled-data and conditional fixed effects) logit models to estimate the probability of abandoning MT.

Our findings explain the variation *between* countries (MT-"leavers" and MT-"stayers") and *within* countries (only MT-"leavers"). The results of the first analysis show that countries which experience liberalization, deregulation and dollarization in their financial systems are more likely to abandon MT. Moreover, we find that the choice of the exchange rate regime influences the probability of a country to leave MT differently conditional on its level of financial openness. Countries with limited capital mobility can use money growth targets and have fixed exchange rates at the same time. In addition, more economically developed countries are inclined to quit MT. The results of the second analysis suggest that the probability of MT abandonment by MT-"leavers" is affected by their financial development and deregulation. Also, more developed MT-"leavers" with past low inflation and larger fiscal deficits are more likely to leave MT.

The results are sensitive to the exclusion of some countries. For advanced countries, financial liberalization and dollarization have a significant impact on the probability to leave MT. Meanwhile, financial liberalization and development contribute to the probability of MT abandonment by emerging and developing countries.

Since none of the advanced countries is currently applying MT, the policy implications of this study are primarily for emerging and developing countries that are still implementing MT. These countries are going through financial evolution processes that include financial liberalization, deregulation and development. In these circumstances, they will soon experience the increasing instability of money demand that may force them to reconsider their choice of MT. Thus, the findings of this paper can be helpful for understanding which financial system characteristics and reforms can affect monetary policy conduct in emerging and developing MT countries and how these financial (and other) factors may lead to countries' decision to exit MT.

References

Abiad, A., E. Detragiache, and T. Tressel (2008). "A New Database of Financial Reforms." IMF Working Paper No. 08/266.

Acemoglu, D., S. Johnson, P. Querubin, and J.A. Robinson (2008). "When Does Policy Reform Work? The Case of Central Bank Independence." NBER Working Paper No. 14033.

Ai, C. and E.C. Norton (2003). "Interaction Terms in Logit and Probit Models." *Economics Letters,* 80(1), 123-129.

Al-Mashat, R. and A. Billmeier (2007). "The Monetary Transmission Mechanism in Egypt." IMF Working Paper No. 07/285.

Argy, V., A. Brennan, and G. Stevens (1990). "MT: The International Experience." *Economic Record,* 66(192), 37-62.

Arnone, M., B.J. Laurens, J.-F. Segalotto, and M. Sommer (2007). "Central Bank Autonomy: Lessons from Global Trends." IMF Working Paper No. 07/88.

Ball, L. (2001). "Another Look at Long-Run Money Demand." *Journal of Monetary Economics*, 47(1), 31-44.

Baltagi, B. (2008). *Econometric Analysis of Panel Data.* 4th Edition. Chichester: Wiley.

Beck, N., J.N. Katz, and R. Tucker (1998). "Taking Time Seriously: Time-Series-Cross-Section Analysis with a Binary Dependent Variable." *American Journal of Political Science,* 42(4), 1260-1288.

Beck, T., A. Demirgüç-Kunt, and R. Levine (2009). "Financial Institutions and Markets Across Countries and Over Time. Data and Analysis." World Bank Policy Research Working Paper No. 4943.

Bernanke, B.S., and I. Mihov (1997). "What Does the Bundesbank Target?" *European Economic Review*, 41(6), 1025-1053.

Bordo, M.D. and L. Jonung (1990). "The Long-Run Behavior of Velocity: The Institutional Approach Revisited." *Journal of Policy Modeling,* 12(2), 165-197.

Brambor, T., W.R. Clark, and M. Golder (2006). "Understanding Interaction Models: Improving Empirical Analyses." *Political Analysis,* 14, 1-20.

Calderón, C., and K. Schmidt-Hebbel (2008). "What Drives the Choice of Money-Based Targets in the World?" Central Bank of Chile Working Papers No. 479.

Calvo, G.A. and C. Reinhart (2000). "Fear of Floating." NBER Working Paper No. 7993.

Cameron, C.A., and P.K. Trivedi (2005). *Microeconometrics: Methods and Applications.* New York: Cambridge University Press.

Chinn, M.D., and H. Ito (2008). "A New Measure of Financial Openness." *Journal of Comparative Policy Analysis*, 10, 309–322.

Cukierman, A., G.P. Miller, and B. Neyapti (2002). "Central Bank Reform, Liberalization and Inflation in Transition Economies – an International Perspective." *Journal of Monetary Economics* 49(2), 237-264.

De Haan, J., S. Oosterloo, and D. Schoenmaker (2009). *European Financial Markets and Institutions.* Cambridge: Cambridge University Press.

De Nicoló, G., P. Honohan, and A. Ize (2003). "Dollarization of the Banking System: Good or Bad?" IMF Working Paper No. 03/146.

Demster, A.P., N.M. Laird, and D.B. Rubin (1977). "Maximum Likelihood from Incomplete Data via the EM Algorithm." *Journal of the Royal Statistical Society. Series B (Methodological),* 39(1), 1-38.

Fane, G. (2005). "Post-crisis Monetary and Exchange Rate Policies in Indonesia, Malaysia and Thailand." *Bulletin of Indonesian Economic Studies*, 41(2), 175–195.

Fatás, A., I. Mihov, and A.K. Rose (2004). "Quantitative Goals for Monetary Policy." NBER Working Paper No. 10846.

Festić, M. (2002). "The Conditions for MT in Slovenia." *Eastern European Economics*, 40(3), 69-89.

Goldfeld, S.M., and D.E. Sichel (1990). "The Demand for Money." In: Friedman, B.N., and F.H. Hahn (Eds.): *Handbook of Monetary Economics.* Volume 1*,* Amsterdam: North-Holland, Chapter 8, pp. 299-356.

Gropp, R., C.K. Sorensen, and J-D. Lichtenberger (2007). "The Dynamics of Bank Spreads and Financial Structure." ECB Working Paper Series No. 714.

Henry, P.B. (2007). "Capital Account Liberalization: Theory, Evidence, and Speculation." *Journal of Economic Literature,* 45(4), 887-935.

Houben, A.C.F.J. (1997). "Exchange Rate Policy and Monetary Strategy Options in the Philippines – The Search for Stability and Sustainability." IMF Paper on Policy Analysis and Assessment No. 97/4.

Houben, A.C.F.J. (1999). *The Evolution of Monetary Policy Strategies in Europe*. PhD thesis, Rijksuniversiteit Groningen.

Issing, O. (1997). "MT in Germany: The Stability of Monetary Policy and of the Monetary System." *Journal of Monetary Economics*, 39(1), 67-79.

Judd, J.P. and J.L. Scadding (1982). "The Search for a Stable Money Demand Function: A Survey of the Post-1973 Literature." *Journal of Economic Literature,* 20(3), 993-1023.

Keller, P.M., and T. Richardson (2003). "Nominal Anchors in the CIS." IMF Working Paper No. 03/179.

Klomp, J. and J. de Haan (2010). "Do Central Bank Law Reforms Affect the Term in Office of Central Bank Governors?" *Economics Letters,* 106(3), 219-222.

Krugman, P. and M. Obstfeld (2009). *International Economics. Theory and Policy.* 8th edition, Pearson Addison-Wesley.

Levine, R., N. Loayza, and T. Beck (2000). "Financial Intermediation and Growth; Causality and Causes." *Journal of Monetary Economics*, 46(1), 31-77.

Levy-Yeyati, E. (2006). "Financial Dollarization: Evaluating the Consequences." *Economic Policy*, 21(45), 61-118.

McCallum, B.T. (1985). "On Consequences and Criticisms of Monetary Targeting." NBER Working Paper No. 1596.

Mishkin, F.S. (1999). "International Experiences with Different Monetary Policy Regimes." *Journal of Monetary Economics*, 43(3), 579-605.

Mishkin, F.S. (2006). "Monetary Policy Strategy: How Did We Get Here?" NBER Working Paper No. 12515.

Mishkin, F.S., and A. Estrella (1997). "Is There a Role for Monetary Aggregates in the Conduct of Monetary Policy?" *Journal of Monetary Economics*, 40(2), 279-304.

Mishkin, F.S., and M. Savastano (2001). "Monetary Policy Strategies for Latin America." *Journal of Development Economics*, 66(2), 415-444.

Nassar, K. (2005). "Money Demand and Inflation in Madagascar." IMF Working Paper No. 05/236.

Obstfeld M., J.C. Shambaugh and A.M. Taylor (2005). "The Trilemma in History: Tradeoffs among Exchange Rates, Monetary Policies, and Capital Mobility." *The Review of Economics and Statistics*, 87(3), 423-438.

Patra, M.D. and M. Kapur (2010). "A Monetary Policy Model without Money for India." IMF Working Paper No. 10/183.

Reinhart, C., and K. Rogoff (2004). "The Modern History of Exchange Rate Arrangements: A Reinterpretation." *Quarterly Journal of Economics*, 119(1), 1-48.

Rich, G. (1997). "Monetary Targets as a Policy Rule: Lessons from the Swiss Experience." *Journal of Monetary Economics*, 39(1), 113-141.

Roger, S. (2009). "Inflation Targeting at 20: Achievements and Challenges." IMF Working Paper No. 09/236.

Schafer, J.L. (1997). *Analysis of Incomplete Multivariate Data.* Monographs on Statistics and Applied Probability No 72, London: Chapman&Hall.

Slok, T. (2002). "Money Demand in Mongolia: A Panel Data Analysis." *IMF Staff Papers*, 49(1), 128-135.

Sterne, G. (2001). "Inflation Targets in a Global Context." Central Bank of Chile Working Papers No. 114.

Stone, M.R., and A.J. Bhundia (2004). "A New Taxonomy of Monetary Regimes." IMF Working Paper No. 04/191.

Tan, E.C. (1997). "Money Demand amid Financial Sector Developments in Malaysia." *Applied Economics,* 29(9), 1201-1215.

Tufano, P. (2003). "Financial Innovation." In: Constantinides, G., M. Harris, and R.M. Stulz (Eds.): *Handbook of the Economics of Finance: Volume 1A. Corporate Finance*. Amsterdam: North-Holland, Chapter 6, pp. 307-336.

Von Hagen, J. (1999). "Money Growth Targeting by the Bundesbank." *Journal of Monetary Economics*, 43(3), 681-701.

Woodford, M. (2008). "How Important is Money in the Conduct of Monetary Policy?" *Journal of Money, Credit and Banking*, 40(8), 1561-1598.

ANNEX

Table A1. Variables and data sources

Variable	Description	Expected sign	Data sources
Financial liberalization	Chinn-Ito index of capital account openness. The index takes values from -1.86 to 2.46.	+	Chinn and Ito (2008)
Financial deregulation	Financial deregulation index includes 5 dimensions. On each dimension the scale is 0-3 (0 = full repression, 3 = full liberalization). The index takes values from 0 to 15.	+	Abiad et al. (2008)
Financial development	Domestic credit provided by the banking sector /GDP	+	WDI&GDF World Bank
Financial dollarization	Reserves dollarization: Foreign currency reserves/ total reserves Deposit dollarization: Foreign currency deposits/total bank deposits	+	IFS IMF, Levy-Yeyati (2006), national and central banks' statistics
Economic development	GDP per capita, in 2000 USD (ln)	+	WDI&GDF World Bank
Inflation	Annual CPI inflation rate, transformed as $\frac{\pi/100}{1+\pi/100}$	-	WEO&IFS IMF
Exchange rate regime	Indicator, from 1 (hard peg) to 14 (freely falling). In several cases it takes the value 15 (dual market).	+/-	Reinhart and Rogoff (2004)
Money growth volatility	3-year rolling standard deviation of annual broad money growth rates (M3 or M2, depending on country data)	+	WDI&GDF World Bank, Datastream
Trade openness	Sum of export and import of goods and services as percentage of GDP	+	WDI&GDF World Bank, IFS IMF, national statistics
Fiscal balance	General government fiscal balance as percentage of GDP	-	WEO&IFS IMF, Datastream, EBRD reports, World Bank Development reports
Central bank independence	Actual central bank independence index (ACBI) = legal index*rule of law	-	Cukierman et al. (2002), Arnone et al. (2007), ICRG database, central banks' laws

Table A2. Correlation matrix (full sample)

		1	2	3	4	5	6	7	8	9	10	11
1	Financial liberalization	1.00										
2	Financial deregulation	**0.48**	1.00									
3	Financial development	**0.52**	**0.21**	1.00								
4	Financial dollarization	**-0.30**	0.001	**-0.30**	1.00							
5	GDP per capita (ln)	**0.62**	**0.27**	**0.73**	**-0.54**	1.00						
6	Inflation	**-0.36**	**-0.25**	**-0.37**	0.06	**-0.32**	1.00					
7	Exchange rate regime	**0.15**	**0.14**	**0.17**	**-0.12**	**0.13**	**0.19**	1.00				
8	Money growth volatility	**-0.15**	-0.01	**-0.26**	**0.11**	**-0.25**	**0.51**	**0.16**	1.00			
9	Trade openness	**-0.24**	**0.23**	**-0.36**	**0.40**	**-0.34**	**0.17**	**-0.11**	**0.24**	1.00		
10	Fiscal balance	**0.20**	**0.39**	**0.09**	**0.08**	**0.16**	**-0.25**	-0.07	**-0.15**	**0.11**	1.00	
11	Central bank independence	**0.64**	**0.46**	**0.38**	**-0.25**	**0.49**	**-0.33**	0.005	-0.08	0.02	**0.18**	1.00

Notes: Numbers in bold indicate correlation coefficients that are significant at the 5 % significance level.

Table A3. Correlation matrix (MT-"leavers")

		1	2	3	4	5	6	7	8	9	10	11
1	Financial liberalization	1.00										
2	Financial deregulation	**0.55**	1.00									
3	Financial development	**0.58**	**0.34**	1.00								
4	Financial dollarization	**-0.16**	0.06	**-0.11**	1.00							
5	GDP per capita (ln)	**0.66**	**0.36**	**0.63**	**-0.35**	1.00						
6	Inflation	**-0.45**	**-0.30**	**-0.41**	0.05	**-0.40**	1.00					
7	Exchange rate regime	**0.13**	0.07	**0.24**	-0.07	0.07	**0.17**	1.00				
8	Money growth volatility	**-0.19**	-0.05	-0.27	**0.15**	**-0.32**	**0.59**	**0.15**	1.00			
9	Trade openness	**-0.29**	**0.24**	**-0.39**	**0.41**	**-0.42**	**0.21**	-0.10	**0.27**	1.00		
10	Fiscal balance	**0.26**	**0.41**	0.10	**0.13**	**0.21**	**-0.26**	-0.07	**-0.19**	**0.22**	1.00	
11	Central bank independence	**0.70**	**0.51**	**0.33**	**-0.20**	**0.49**	**-0.32**	0.02	-0.10	-0.02	**0.16**	1.00

Notes: Numbers in bold indicate correlation coefficients that are significant at the 5 % significance level.

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